

Nov 98

FINAL REPORT

FIFTH ST. LOUIS WORKSHOP ON WIDE BANDGAP NITRIDES

Submitted to

Army Research Office

Dr. J. Zavada

P.O. Box 12211

Research Triangle Park NC 27709-2211

TEL: 919 549 4297

FAX: 919 549 4310

e mail: zavada@aro-emh1.army.mil

Office of Naval Research

Dr. Y. S. Park

Code 312

800 N. Quincy St.

Arlington, VA 22217

TEL: (703) 696-5755

FAX: (703) 696-2611

e mail: parky@onr.navy.mil

submitted by

Hadis Morkoç

Department of Electrical Engineering and Physics Department
Virginia Commonwealth University

P. O. Box 843072

Richmond, VA 23284-3072

TEL: (804) 827-3765

FAX: (804) 828-4269

e mail: hmorkoc@vcu.edu

DISTRIBUTION STATEMENT A

Approved for public release

Distribution Unlimited

19981217 060

Final report, fifth St. Louis Workshop on Wide Bandgap Nitrides

The fifth St. Louis Workshop in Wide Bandgap Nitrides was held August 4-7, 1998 in St. Louis, MO. The workshop was attended by some 80 researchers from mainly the United States and very topical and bottleneck type problems/issues were discussed. The workshop is unique in its approach in that short presentations on pertinent issues are followed by lengthy discussion. Following a group of somewhat related presentations, an overall discussion period involving the authors of that session and the audience is conducted. The forum provides a plenty of time for discussions of important and unresolved issues as opposed presenting polished and finished results typically presented in standard/conventional meeting. The participants over the years have been and are still supportive of the role the workshop plays for the community. It should be mentioned that this workshop carries the distinction of being the first ever meeting in the field in the world.

In 1992 the first-ever Nitride Workshop, and in October 1994 the second, in March 1996 the third, in October 1997 the fourth one, and in August 1998 the fifth one were convened with great successes, bringing together practitioners and theorists, and those who are in a position to have an impact. Much progress has been made toward realizing many of the concepts presented in the first and the second workshops. The response of participants to the first, second, third and fourth workshops was very enthusiastic, and many inquiries have been received since concerning the fifth workshop. A fifth such workshop held in an open forum will facilitate exchange of knowledge and information about recent developments in equipment, growth methods, growth issues particular to each method including lateral growth and associated spatial migration rates, new theoretical findings, dopant (both n and p type) incorporation and likely approaches to be employed, and potential applications to emitters, detectors and electronic devices. In particular the nitride community is at a turning point with respect to the best suited nitrogen source for vacuum deposition and surfactants to enhance migration rates. A workshop of this kind is ideal for bringing the experts in the field together for a hearty discussion of pivotal issues, such as defects, substrates, dopants, and other issues pertinent to devices for rapid progress to follow.

This report contains the announcement for the workshop, abstracts that have been submitted in addition to the solicited speakers, and the workshop program.

FIFTH ST. LOUIS WORKSHOP ON WIDE BANDGAP NITRIDES ANNOUNCEMENT

Fifth Wide Bandgap Nitride Semiconductor Workshop
Adams Mark Hotel, St. Louis MO USA
August 4-7, 1998

The Fifth Workshop on Wide Bandgap Nitride Semiconductors will be held at the Adam's Mark Hotel near the famous St. Louis Gateway Arch by the Mississippi River in St. Louis, MO, on August 4-7, 1998. This date was previously selected and announced at the Fourth Workshop in March 1997. As you probably know, this is the location at which the previous four Workshops have been held.

The registration information, including the registration fee and the information on where to send the registration fee will be sent in the very near future.

Commencing with a reception on Tuesday evening, August 4, 1998 at 6:00 PM, the Workshop attendees will be treated to the famed Adam's Mark breakfast, lunch, and dinner, as well as coffee breaks on each of the three conference days, except that lunch will not be provided on Friday, August 7, due to the fact that no technical sessions will be scheduled for Friday afternoon.

In making hotel reservations, be certain to mention that you will be attending the Fifth Workshop on Wide-Bandgap Nitrides with local arrangements by Prof. Hadis Morkoç, Virginia Commonwealth University. The key words that will be used by the hotel reservation personnel are "Wide-Bandgap Nitride Workshop", so please fully identify the workshop by this name. Rates are \$115 and \$125 for single- and double-occupancy, respectively. The hotel can often be full during the time of this conference. Consequently, it is imperative that you make your reservation early. A limited number of rooms with government rates is also available, however, be certain to mention it at the time you make your hotel reservation. You must present your government ID at the time of registration to qualify for this rate. After July 3, 1998, the block of reserved rooms will be released for sale to the general public. For reservations call TEL: (314) 241-7400, FAX: (314) 241-6618. The Adam's Mark Hotel is located at Fourth and Chestnut Streets, St. Louis, MO 63102, approximately five minutes from Union Station, adjacent to the Gateway Arch.

St. Louis' Lambert International Airport can be easily accessed by air from most cities in the United States and many major cities throughout the world. The airport limousine costs about \$10 per person one way and \$15 round trip with pick up at Door 13 by the Baggage Claim Area.

We look forward to seeing you in St. Louis in August!

Russell D. Dupuis, Workshop Program Chair (dupuis@mail.utexas.edu, 512 471-0537).

Hadis Morkoç, Workshop Arrangements Chair (hmorkoc@vcu.edu, 804 828-0181).

**Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998**

Session	Time	Authors (Presenter's Name in Bold)	Contact e-Mail	Title of Talk
TUE 8/4	4-8PM	WORKSHOP REGISTRATION OPEN		
Reception	6:00	WORKSHOP WELCOMING RECEPTION — Adam's Mark Hotel (Room ???)		
WED 8/5	7:15	CONTINENTAL BREAKFAST		
WA-0	8:15	WELCOME AND OPENING REMARKS — Hadis Morkoç, Russell Dupuis		
WA-1	8:30	Bulk Substrates and MBE —		
WA 1.1	8:45	M. Suscavage, M. Harris, D. Bliss, P. Yip, S. Q. Wang, D. Schwalli, L. Bouthilllette, M. N. Alexander , J. Bailey, M. Callahan, D. C. Look, D. C. Reynolds, R. L. Jones, and C. W. Litton	alexande@maxwell.rli.ph.af.mil	High Quality Hydrothermal ZnO Crystals
WA-1.2	9:00	L. J. Schowalter	schowl@rpi.edu	Bulk AlN Substrate Characterization
WA-1.3	9:15	J. E. Nause and G. Agarwal	cermeting@juno.com	Growth of Bulk ZnO Crystals for Wide Bandgap Applications
WA-1.4	9:30	R. Held, S. Seutter, B. E. Ishaug, A. Parkhomovsky, A. M. Dabiran, P. I. Cohen , G. Knowak, I. Grzegory, and S. Porowski	cohen@ece.umn.edu	Nitride MBE on Bulk Substrates
WA-1.5	9:45	C. W. Litton , D. C. Reynolds, J. Van Nostrand, D. C. Look, R. L. Jones, F. Hamandi, H. Tang, W. Kim, A. Salvador, A. Botcharev, M. Yeadon, J. Gibson, D. J. Smith, M. Skowronski, and H. Morkoç	litton@el.wpafb.af.mil	Reactive MBE Growth and Characterization of GaN on the Polar Faces of Bulk C-plane ZnO Substrates
WA-1HT	10:00	Short Presentations & Hot Topic Discussions		
	10:15	BREAK		
WA-2	10:30	Nitride Epitaxy I (MBE and VPE) —		
WA-2.1	10:30	W. J. Schaff , M. Murphy, T. Eustis, H. Wu, W. Yeo, O. Ambacher, J. Smart, J. R. Shealy and L. F. Eastman	schaff@iiv.tn.cornell.edu	MBE Growth of Normal and Inverted 2-dimensional Electron Gases in GaN
WA-2.2	10:45	H. Morkoç	hmorkoc@vcu.edu	MBE Growth of Nitride Materials
WA-2.3	11:00	R. Beccard, M. Heuken, H. Juergensen , O. Panilaud, M. Illegems	juer@aixtron.com	Design Issues and Operation of GaN Hydride VPE Systems
WA-2.4	11:15	A. E. Nikolaev, Y. V. Melnik, N. I. Kuznetsov, and V. A. Dmitriev	vladimir@tdii.com	Insulating GaN Grown on SiC by HVPE
WA-2.5	11:30	Y. V. Melnik, A. E. Nikolaev, S. I. Stepanov, and V. A. Dmitriev	vladimir@tdii.com	Aluminum Nitride Grown by HVPE
WA-2HT	11:45	Short Presentations & Hot Topic Discussions		

12/6/98

Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998

	12:00	LUNCH—Adam's Mark Hotel Room ???		
--	-------	----------------------------------	--	--

**Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998**

Session	Time	Authors (Presenter's Name in Bold)	Contact e-Mail	Title of Talk
WP-1	1:30	Nitride Epitaxy II (MOCVD and MBE) and Materials Processing —		
WP-1.1	1:30	D. Doppalapudi, M. Misra, D. Korakakis, E. Iliopoulos, S. N. Basu, K. F. Ludwig, Jr., and T. D. Moustakas	tdm@panda.bu.edu	Long-Range Atomic Ordering in InGaAlN Alloys
WP-1.2	1:45	S. Keller, S. F. Chichibu, M. S. Minsky, A. C. Abare, L. A. Coldren, U. K. Mishra, and S. P. DenBaars	stacia@ece.ucsb.edu	MOCVD Growth of InGaN/GaN Single and Multi Quantum Wells
WP-1.3	2:00	M. A. Khan, J. Yang, and T. W. Weeks, Jr.	asif@engr.sc.edu	MOCVD of III-Nitrides for Optoelectronic and Microelectronic Device Applications
WP-1.4	2:15	J. R. Shealy	shealy@anise.ee.cornell.edu	A Single Temperature Process for the Nucleation and Growth of Device Quality AlGaIn/GaN Materials
WP-1.5	2:30	H. P. Gillis, M. J. Christopher, K. P. Martin, and D. A. Choutov	gillis@chem.ucla.edu	Patterning III-N Semiconductors by Low Energy Electron Enhanced Etching (LE4)
WP-1.6	2:45	C.R. Eddy, D. Leonhardt, B. Molnar, V. A. Samamia	ceddy@engc.bu.edu	Issues and Mechanisms in High-Density Plasma Etching of GaN
WP-1HT	3:00	Short Presentations & Hot Topic Discussions		
	3:15	BREAK		
WP-2	3:30	Nitride Epitaxy III (Lateral Epitaxial Overgrowth) —		
WP-2.1	3:30	R. Davis, A. Banks, D. Hanser, E. Carlson, et al.	Robert_Davis@ncsu.edu	Single and Double Lateral Epitaxial Overgrowth of GaN on SiC
WP-2.2	3:45	S. P. DenBaars, H. Marchand, J. P. Ibbetson, P. T. Fini, S. Chichibu, S. J. Rosner, S. Keller, J. S. Speck, and U. K. Mishra	denbaars@engineering.ucs b.edu	Lateral Epitaxial Overgrowth (LEO) of Low Defect Density GaN on Sapphire and Si (111) Substrates
WP-2.3	4:00	J. Park, P. A. Grudowski, C. J. Eiting, R. D. Dupuis, and Z. Liliental-Weber	dupuis@mail.utexas.edu	Growth and Properties of Lateral Epitaxial Overgrown III-N Materials by Metalorganic Chemical Vapor Deposition
WP-2.4	4:15	P. Kung, D. Walker, M. Hamilton, J. Diaz, and M. Razeghi	razeghi@epsilon.ece.nyu.edu	Lateral Epitaxial Overgrowth of GaN Thin Films on Sapphire and Silicon
WP-2.5	4:30	W. Yang, S. A. McPherson, Z. Mao, S. McKernan, and C. B. Carter	yang_wei@htc.honeywell.com	Lateral Epitaxial Overgrowth of GaN/AlN on Si
WP-2.6	4:45	Z. Liliental-Weber, J. Washburn, J. Park, P. A. Grudowski, C. J. Eiting, and R. D. Dupuis	z_liliental-weber@lbl.gov	TEM Study of Defects in Laterally Overgrown GaN Layers
WP-2.7	5:00	J. A. Freitas, Jr., O. H. Nam, R. F. Davis, G. V. Saperin, and S. K. Obyden	freitas@bloch.nrl.navy.mil	Intrinsic Properties of Lateral Epitaxial Overgrown GaN Layers
WP-2.8	5:15	K. J. Nam, A. Sampath, D. Doppalapudi, H. M. Ng, R. S. Mann, E. Iliopoulos, M. Misra, and T. D. Moustakas	tdm@panda.bu.edu	Lateral Epitaxial Overgrowth of GaN on Sapphire by the VPE Method
WP-2.9	5:30	J. R. Shealy, J. A. Smart, and E. M. Chumbes	shealy@anise.ee.cornell.edu	Single-Step, Single-Temperature Process for Epitaxial Lateral Overgrowth of GaN on SiC and Sapphire Substrates
WP-2HT	5:45	Short Presentations & Hot Topic Discussions		
	7:00	WORKSHOP BUFFET DINNER—Adam's Mark Hotel Room ???		

**Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998**

Session	Time	Authors (Presenter's Name in Bold)	Contact e-Mail	Title of Talk
THUR 8/6	7:15	CONTINENTAL BREAKFAST		
TA-1	8:15	Electronic Properties and Devices —		
TA-1.1	8:15	J. C. Zolper	zolperj@onr.navy.mil	Overview of US Navy Interest in Wide-Bandgap Semiconductors
TA-1.2	8:30	A. F. Fung, C. Cai, P. P. Ruden, M. I. Nathan , M. Y. Chen, B. T. McDermott, and G. J. Sullivan	nathan@ece.umn.edu	Hydrostatic and Uniaxial Stress Dependence of the Channel Conductivity of n-AlGaIn/GaN Modulation Doped Structures on Sapphire Substrates
TA-1.3	8:45	B. T. McDermott , R. Pittman, M. Chen, and E. Gertner	btmcderm@rsc.rockwell.com	Recent Results on 2DEG Mobilities for AlGaIn/GaN Heterostructures
TA-1.4	9:00	L. F. Eastman and K. Chu	lfe@iliv.tn.cornell.edu	Piezoelectric AlGaIn/GaN Microwave Power HEMT's
TA-1.5	9:15	R. Gaska , A. Ping, I. Adesida, A. Dickens, M. S. Shur, V. Kuksenkov, and H. Temkin	remis@apaoptics.com	High-Frequency, Low-Noise Performance of AlGaIn-GaN HFETs on Insulating 4H-SiC at Elevated Temperatures
TA-1.6	9:30	R. Gaska , A. Ping, I. Adesida, A. Dickens, and M. S. Shur	remis@apaoptics.com	AlGaIn/GaN-based HFETs for Digital Applications
TA-1HT	9:45	Short Presentations & Hot Topic Discussions		
	10:00	BREAK		
TA-2	10:15	HFETs and Photodetectors —		
TA-2.1	10:15	R. P. Vaudo, V. M. Phanse, J. M. Redwing , Z. Z. Bandic, P. M. Bridger, E. C. Piquette, R. A. Beach, and T. C. McGill	jredwing@atmi.com	GaN Epitaxy for High Power Devices
TA-2.2	10:30	B. J. Thibeault , Y. F. Wu, B. P. Keller, and U. K. Mishra	thibeault@witech.com	Correlation of Trapping Effect to Microwave Power Performance of AlGaIn/GaN HEMTs
TA-2.3	10:45	D. Grider , C. Nguyen, N. Nguyen	dgrider@hrl.com	GaN MODFET Microwave Power Technology
TA-2.4	11:00	D. L. H. Lambert and R. D. Dupuis	dupuis@mail.utexas.edu	Modeling of AlGaIn HFET Performance
TA-2.5	11:15	W. Yang , T. Nohava, R. Torrealano, S. McPherson, and H. Marsh	yang_wei@htc.honeywell.com	High Gain GaIn/AlGaIn Heterojunction Phototransistor
TA-2.6	11:30	J. C. Carrano , T. Li, D. Brown, P. A. Grudowski, C. J. Eiting, R. D. Dupuis, and J. C. Campbell	jcarrano@mail.utexas.edu	High-speed UV III-V Nitride Photodetectors
TA-2.7	11:45	M. Schurman , J. Ramer, C. Tran, I. Ferguson, T. Li, J. C. Carrano, and J. C. Campbell	matt@emcore.com	The Relationship in Material Quality to Breakdown Mechanisms in AlGaIn Based Photodetectors
TA-2.8	12:00	S. Krishnakutty , W. Yang, and T. Nohava	krishnakutty_subash@htc.honeywell.com	Growth and Characterization of AlGaIn and Development of AlGaIn Based Photodiodes
TA-2HT	12:15	Short Presentations & Hot Topic Discussions		
	12:30	LUNCH — ON YOUR OWN — EXPLORE St. Louis		

**Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998**

Session	Time	Authors (Presenter's Name in Bold)	Contact e-Mail	Title of Talk
TP-1	2:00	Optoelectronic Devices and Processing —		
TP-1.1	2:00	H. P. Maruska , M. Lioubtshenko, M. Osinski, S. Pearton, and R. Shul	maruska@pop.tiac.net	GaN Blue Light-Emitting Diodes Created by Ion Implantation
TP-1.2	2:15	C. H. Chen , G. Christenson, W. Goetz, S. Lester, H. Liu, P. Martin, S. Kern, M. Perry, S. Rudaz, D. Steigerwald, J. Yu, L. Cook, R. M. Fletcher, C. P. Kuo, and M. G. Craford	changhua_chen@hp.com	Bright Nitride LEDs by MOCVD
TP-1.3	2:30	D. A. Stocker , E. F. Schubert, K. S. Boutros, and J. M. Redwing	efs@bu.edu	Fabrication of Smooth GaN-based Laser Facets
TP-1.4	2:45	A. C. Abare, M. P. Mack, M. Hansen, R. K. Sink, P. Kozodoy, S. Keller, J. S. Speck, J. E. Bowers, U. K. Mishra, L. A. Coldren, and S. P. DenBaars	denbaars@engineering.ucs.b.edu	Cleaved and Etched Facet Blue-violet Laser Diodes
TP-1.5	3:00	J. J. Song , S. Bidnyk, T. J. Schmidt, Y. H. Cho, S. Keller, S. P. DenBaars and W. Yang	jjsong@okway.okstate.edu	Stimulated Emission Studies of MOCVD-Grown GaN and InGaN Structures
TP-1.6	3:15	J. E. Edmond , K. Doverspike, H. K. Kong, M. Leonard, H. Dieringer, and D. Emerson.	john_edmond@cree.com	GaN Based Emitters on SiC Grown by MOCVD
TP-1HT	3:30	Short Presentations & Hot Topic Discussions		
	3:45	BREAK		
TP-2	4:00	Optical Characterization of Nitride Materials —		
TP-2.1	4:00	M. J. Bergman , H. C. Casey, Jr., J. F. Muth, Y. C. Chang, R. M. Kolbas, R. A. Rao, C. B. Eom, and M. Schurman	mjb@phy.duke.edu	Optical Properties of Mg-doped Al 0.09 Ga 0.91 N with Protrusions from a Smooth Surface
TP-2.2	4:15	Y. H. Cho, T. J. Schmidt, S. Bidnyk, G. H. Gainer, J. Song , S. Keller, S. P. DenBaars	jjsong@okway.okstate.edu	Optical Characterization of GaN, InGaN, and InGaIn/GaN Multiple Quantum Wells Grown by Metalorganic Chemical Vapor Deposition
TP-2.3	4:30	A. Eisenbach , D. Pavlidis, A. Philippe, C. Bru-Chervallier, C. Dubois, and G. Guillot	pavlidis@umich.edu	Photoluminescence and X-ray Diffraction Characteristics of GaN Layers Grown on Sapphire and SOI Substrates
TP-2.4	4:45	M. Osinski , P. G. Eliseev, and V. A. Smagley	osinski@chtm.unm.edu	Band-Tailing Effects in Optical Properties of InGaN Films
TP-2.5	5:00	S. Kim, S. J. Rhee, J. M. Myoung, K. Kim, X. Li, J. J. Coleman, and S. G. Bishop	sgbishop@uiuc.edu	A Study of Er3+ Photoluminescence (PL) in Er-implanted GaN
TP-2.6	5:15	M. Feng , H. Hsia, Z. Tang, D. Becher, R. D. Dupuis, P. A. Grudowski, and C. J. Eiting	mfeng@hsic.cesm.uiuc.edu	Optical and Electrical Studies of Ion-Implanted GaN
TP-2.7	5:30	E. Iliopoulos, D. Doppalapudi, H. M. Ng, and T. D. Moustakas	tdm@panda.bu.edu	Near Bandgap Photoluminescence in n-GaN Films
TP-2HT	5:45	Short Presentations & Hot Topic Discussions		
	7:00	WORKSHOP BUFFET DINNER—Adam's Mark Hotel Room ???		

**Fifth Wide Bandgap Nitride Semiconductor Workshop Schedule,
St. Louis MO, 4-7 August 1998**

Session	Time	Authors (Presenter's Name in Bold)	Contact e-Mail	Title of Talk
FRI 8/7	7:15	CONTINENTAL BREAKFAST		
FA-1	8:30	Materials Characterization —		
FA-1.1	8:30	M. D. Bremser , H. Protzmann, B. Wachtendorf, O. Schoen, D. Schmitz, M. Heuken, E. Woelk, and H. Juergensen	mb@aixtron.com	Growth of InGaN/GaN Device Structures for the Optimization of Multiwafer MOVPE Reactors
FA-1.2	8:45	Z. Liliental-Weber , B. Monemar, and J. Washburn	z_liliental-weber@lbl.gov	Polarity of Homoepitaxial and Heteroepitaxial GaN
FA-1.3	9:00	Z. Q. Fang , D. C. Reynolds, and D. C. Look	zqf@corvus.wright.edu	Electrical Characterization Associated with Degradation of InGaN Blue Light-Emitting Diodes
FA-1.4	9:15	A. K. Fung, J. A. Borton, M. I. Nathan , J. M. Van Hove, and R. Hickman II	afung@ece.umn.edu	A Study of the Electrical Characteristics of Various Metal Contacts to p-type GaN
FA-1.5	9:30	A. Saxler , M. Ahoujja, W. C. Mitchell, P. Kung, X. Zhang, D. Walker, and M. Razeghi	saxleraw@ml.wpafb.af.mil	Electrical Properties of AlGaIn Growth
FA-1.6	9:45	A. K. Rice and K. J. Malloy	arice@chtm.chtm.unm.edu	Temperature Dependent Hall Measurements and Noise Processed in Magnesium-Doped GaN Grown on Sapphire
FA-1.7	10:00	D. C. Look and J. R. Sizelove	lookd@el.wpafb.af.mil	Effect of Threading Dislocations on Mobility in GaN
FA-1HT	10:15	Short Presentations & Hot Topic Discussions		
	10:30	Closing Remarks		
	10:45	BREAK		
	11:00	END OF WORKSHOP		

A	B	C	D	E	F	G	H	I
No	Authors (Presenter Bold)	Presenter's e-Mail	Title of Talk	Sess.	Time	Paper Topic	Other Topics	Notes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								

	A	B	C	D	E	F	G	H	I
16	J. Park, P. A. Grudowski, C. J. Eiting, R. D. Dupuis , and Z. Liliental-Weber		dupuis@mail.utexas.edu	Growth and Properties of Lateral Epitaxial Overgrown III-N Materials by Metalorganic Chemical Vapor Deposition		5			
17									
18	J. A. Freitas, Jr. , O. H. Nam, R. F. Davis, G. V. Saparin, and S. K. Obyden		freitas@bloch.nrl.navy.mil	Intrinsic Properties of Lateral Epitaxial Overgrown GaN Layers		5			
19	P. Kung , D. Walker, M. Hamilton, J. Diaz, and M. Razeghi		razeghi@epsilon.ece.nwu.edu	Lateral Epitaxial Overgrowth of GaN Thin Films on Sapphire and Silicon		5			
20	W. Yang , S. A. McPherson, Z. Mao, S. McKernan, and C. B. Carter		yang_wei@htc.honeywell.com	Selective Area Growth of GaN/AlN on Si		5			
21	K. J. Nam, A. Sampath, D. Doppalapudi, H. M. Ng, R. S. Mann, E. Iliopoulos, M. Misra, and T. D. Moustakas		tdm@panda.bu.edu	Lateral epitaxial overgrowth of GaN on sapphire by the VPE method		5			
22	K. J. Nam, A. Sampath, D. Doppalapudi, H. M. Ng, R. S. Mann, E. Iliopoulos, M. Misra, and T. D. Moustakas		tdm@panda.bu.edu	Lateral epitaxial overgrowth of GaN on sapphire by the VPE method		5			
23	M. J. Bergman , H. C. Casey, Jr., J. F. Muth, Y. C. Chang, R. M. Kolbas, R. A. Rao, C. B. Eom, and M. Schurman		mjb@phy.duke.edu	Optical Properties of Mg-doped Al 0.09 Ga 0.91 N with Protrusions from a Smooth Surface		6	10		
24	A. Eisenbach , D. Pavidis, A. Philippe, C. Bru-Chevallier, C. Dubois, and G. Guillot		pavidis@umich.edu	Photoluminescence and X-ray Diffraction Characteristics of GaN Layers Grown on Sapphire and SOI Substrates		6	4,2		
25	D. C. Look and J. R. Sizelove		lookd@el.wpafb.af.mil	Effect of Threading Dislocations on Mobility in GaN		6			
26	A. F. Fung, C. Cai, P. P. Ruden, M. I. Nathan , M. Y. Chen, B. T. McDermott, and G. J. Sullivan		nathan@ece.umn.edu	Hydrostatic and Uniaxial Stress Dependence of the Channel Conductivity of n-AlGaIn/GaN Modulation Doped Structures on Sapphire Substrates		6			
27	M. Osinski , P. G. Eliseev, and V. A. Smagley		osinski@chtm.unm.edu	Band tailing effects in optical properties of InGaIn films		6	10		
28	A. K. Rice and K. J. Malloy		arice@chtm.chtm.unm.edu	Temperature Dependent Hall Measurements and Noise Processed in Magnesium-Doped GaN Grown on Sapphire		6			
29	Y. H. Cho, T. J. Schmidt, S. Bidnyk, G. H. Gainer, J. J. Song , S. Keller, S. P. DenBaars		jjsong@okway.okstate.edu	Optical Characterization of GaN, InGaIn, and InGaIn/GaN Multiple Quantum Wells Grown by Metalorganic Chemical Vapor Deposition		6			
30	M. Feng , H. Hsia, R. D. Dupuis, P. A. Grudowski, and C. J. Eiting		mfeng@hsic.ccsu.uiuc.edu	Optical and Electrical Studies of Ion-Implanted GaN		6			

A	B	C	D	E	F	G	H	I
30	Z. Liliental-Weber , J. Washburn, J. Park, P. A. Grudowski, C. J. Eiting, and R. D. Dupuis	z_liliental-weber@lbl.gov	TEM Study of Defects in Laterally Overgrown GaN Layers		7			
31	Z. Liliental-Weber , M. Bonemara, and J. Washburn	z_liliental-weber@lbl.gov	Polarity of Homoepitaxial and Heterospitaxial GaN		7			
32	D. Doppalapudi, M. Misra, D. Korakakis, E. Iliopoulos, S. N. Basu, K. F. Ludwig, Jr., and T. D. Moustakas	tdm@panda.bu.edu	Long range atomic ordering in InGaAlN alloys		7			
33	S. Kim, S. J. Rhee, J. M. Myoung, K. Kim, X. Li, J. J. Coleman, and S. G. Bishop	sgbishop@uiuc.edu	A Study of Er ³⁺ Photoluminescence (PL) in Er-implanted GaN		8	6, 10		
34	Z. Q. Fang , D. C. Reynolds, and D. C. Look	zqf@corvus.wright.edu	Electrical Characterization Associated with Degradation of InGaN Blue Light-Emitting Diodes		8			
35	A. K. Fung , J. A. Borton, M. I. Nathan, J. M. Van Hove, and R. Hickman II	afung@ece.umn.edu	A Study of the Electrical Characteristics of Various Metal Contacts to p-type GaN		8			
36	A. Saxler , M. Ahouja, W. C. Mitchel, P. Kung, X. Zhang, D. Walker, and M. Razeghi	saxleraw@ml.wpafb.af.mil	Electrical Properties of AlGaIn Growth		8			
37	H. P. Gillis , M. J. Christopher, K. P. Martin, and D. A. Choutov	gillis@chem.ucla.edu	Patterning III-N Semiconductors by Low Energy Electron Enhanced Etching (LE4)		8			
38	C.R. Eddy , D. Leonhardt, B. Molnar, V. A. Samamia	ceddy@engc.bu.edu	Issues and Mechanisms in High-Density Plasma Etching of GaN		8			
39	L. F. Eastman and K. Chu	lfe@iiv.tn.cornell.edu	Piezoelectric AlGaIn/GaN Microwave Power HEMT's		9			
40	R. Gaska , A. Ping, I. Adesida, A. Dickens, M. S. Shur, V. Kuksekov, and H. Temkin	remis@apaoptics.com	High-Frequency, Low-Noise Performance of AlGaIn-GaN HFETs on Insulating 4H-SiC at Elevated Temperatures		9			
41	R. Gaska , A. Ping, I. Adesida, A. Dickens, and M. S. Shur	remis@apaoptics.com	AlGaIn/GaN-based HFETs for Digital Applications		9			
42	D. Grider , C. Nguyen, N. Nguyen	dgrider@hrl.com	GaN MODFET Microwave Power Technology		9	3, 8, 9		
43	R. P. Vaudo, V. M. Phanse, J. M. Redwing , Z. Z. Bandic, P. M. Bridger, E. C. Piquette, R. A. Beach, and T. C. McGill	jredwing@atmi.com	GaN Epitaxy for High Power Devices		9	4		
44	B. J. Thibeault , Y. F. Wu, B. P. Keller, and U. K. Mishra	thibeault@witech.com	Correlation of Trapping Effect to Microwave Power Performance of AlGaIn/GaN HEMTs		9			
45	W. Yang , T. Nohava, R. Torreano, S. McPherson, and H. Marsh	yang_wei@htc.honeywell.com	High Gain GaN/AlGaIn Heterojunction Phototransistor		9			

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 12/10/98	3. REPORT TYPE AND DATES COVERED Final: 5/15/98-11/30/98		
4. TITLE AND SUBTITLE Organization of the Fifth Workshop on Wide Band-gap Nitrides		5. FUNDING NUMBERS N00014-98-1-0613		
6. AUTHOR(S) Hadis Morkoc				
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES) Virginia Commonwealth University School of Engineering PO Box 843068 Richmond, VA 23284-3068		8. PERFORMING ORGANIZATION REPORT NUMBER 1		
9. SPONSORING / MONITORING AGENCY NAMES(S) AND ADDRESS(ES) Office of Naval Research ONR 251: Elizabeth L. Ford Ballston Centre Tower One 800 N. Quincy St.; Arlington, VA 22217-5660		10. SPONSORING / MONITORING AGENCY REPORT NUMBER 1		
11. SUPPLEMENTARY NOTES				
a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release		12. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) The fifth St. Louis Workshop in Wide Bandgap Nitrides was held August 4-7, 1998 in St. Louis, MO. The workshop was attended by some 80 researchers from mainly the United States and very topical and bottleneck type problems/issues were discussed. The workshop is unique in its approach in that short presentations on pertinent issues are followed by lengthy discussion. Following a group of somewhat related presentations, an overall discussion period involving the authors of that session and the audience is conducted. The forum provides a plenty of time for discussions of important and unresolved issues as opposed presenting polished and infished results typically presented in standard/conventional meeting. The participants over the years have been and are still supportive of the role the workshop plays for the community. It should be mentioned that this workshop carries the distinction of being the first ever meeting in the field in the world.				
14. SUBJECT TERMS wide bandgap nitrides, electronic detectors/devices, microelectronics, semiconductors		15. NUMBER OF PAGES 1		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	